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DIRECTORATE OF
SCIENCE & TECHNOLOGY

SCIENTIFIC INTELLIGENCE DIGEST

Secret

[redacted]

[redacted]

February 1969

No. 23

[redacted]

THE SOLAR RADIATION ENVIRONMENT DURING SOYUZ 3 AND FUTURE MANNED FLIGHTS

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The greatest series of solar flares in the present solar cycle occurred during and immediately after the Soyuz 3 manned spaceflight, 26-30 October. The Soviets were aware of this solar activity and evidenced interest and concern in monitoring the radiation levels during cosmonaut Beregovoy's flight. Since the spacecraft was within the earth's magnetic field, however, there was little danger for the cosmonaut during the Soyuz 3 flight. It is believed that the radiation levels inside the spacecraft did not exceed the safe limits and that the solar activity did not necessitate an early recovery of Soyuz 3. There is no evidence that extravehicular activity (EVA) was planned for the Soyuz 3 mission but it is doubtful that such activity would have been attempted during a period of unusually high radiation.

Solar particle radiation presents a hazard to cosmonauts on manned space missions and therefore the timing of future missions will be affected by the level of solar flare activity. The danger can be severe if the cosmonaut is outside of the earth's magnetic field at the time of a solar proton event, but it can be reduced by the spacecraft shielding and by keeping the cosmonaut within the earth's magnetic field.

On 26 October, the day Soyuz 3 was launched, the initial signs of upcoming solar flare activity were noted by the US forecast center. A rapid sequence of small flares occurred from 27 to 29 October. These disturbances produced a very large amount of radio noise but did not include any proton events. This series was the prelude to the major flare which occurred the next day (30 October) just after the Soyuz 3 had reentered the earth's atmosphere. This flare was of Importance 3 (the worst possible solar flare event is Importance 4) and during the next several days a series of large solar flares included two of Importance 2. This high level of solar flare activity continued for several days. Proton events were associated with the activity which began on 30 October.

The Soviets commented on 29 October that astrophysical observatories and geophysical stations in the USSR had registered an increase in solar activity. The flare of Importance 3 was noted by the astronomers at the Ussuriysk Astronomical Observatory; they said that such a powerful flare had not been observed for seven years. The Soviets stated that solar radiation levels measured inside the spacecraft had not exceeded safe limits. [redacted]

[redacted] The protection offered by the Soviet spacecraft and the limiting effect of the earth's atmosphere and geomagnetic field on solar protons and alpha particles would provide a safe radiation environment for the cosmonaut inside the spacecraft.

Since the solar maximum of the 11-year solar cycle is due in 1969-1970, solar flare activity will have an important bearing on the timing of a manned mission, especially those involving EVA activity in earth orbit or on the lunar surface. If the Soviets use a spacecraft for lunar landing with minimum shielding such as the US lunar module, the occurrence of a large proton event while the craft is on the lunar surface would be critical to mission success. The spacesuit would not afford adequate protection for a cosmonaut on the lunar surface during a proton event. EVA in earth orbit probably would be scheduled to avoid such events. The command spacecraft probably would provide enough protection for the cosmonaut on earth orbital and lunar missions.

Collection of solar data from scientific observatories for the USSR is administered by IZMIRAN (Institute of Terrestrial Magnetism, Ionosphere, Radiowave Propagation). The USSR is seeking to achieve round-the-clock monitoring capabilities and is interested in establishing a world-wide warning network. Neither has been achieved. New and improved methods for forecasting solar flare activity by using information on the solar magnetic field and sun spot configurations are being developed under the direction of Dr. A. B. Severney at the Crimean Astrophysical Observatory. No real-time solar monitoring capability is anticipated in the foreseeable future. [redacted]